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***Escherichia coli* on U.S. Swine Sites—Antimicrobial Drug Susceptibility**

Background

E. coli are normal (commensal) flora of the intestines of humans and animals, including swine. While many subtypes of *E. coli* are harmless, others—such as *E. coli* O157:H7—can cause disease. Foodborne *E. coli* infections have been attributed to the consumption of undercooked hamburger and raw (unpasteurized) milk, as well as contaminated fruits, vegetables, water, and exposure to live animals and their environments.¹ However, past studies have shown that it is uncommon for swine to shed *E. coli* O157:H7.²

Although not necessarily pathogenic, commensal *E. coli* residing in the intestinal tracts of humans and animals may contain genes for resistance to antimicrobials. If the animal becomes infected with pathogenic bacteria, it is possible for the antimicrobial resistance genes to be transferred to those bacteria and thus render treatment with those antimicrobials ineffective. Understanding antimicrobial susceptibility of commensal *E. coli* can help identify emerging patterns of resistance that may also occur in disease-causing organisms.

***E. coli* on U.S. swine sites**

In 2006, USDA's National Animal Health Monitoring System (NAHMS) conducted a study on swine health and management practices from a random sample of swine production sites with 100 or more pigs in 17 States*. These States represented approximately 94 percent of U.S. pig inventory and 94 percent of U.S. pork producers with 100 or more pigs.

As part of Swine 2006, fecal samples were collected from pen floors on 135 sites. On each site, up to 15 fecal samples were collected from pens containing grower/finisher pigs and cultured for *E. coli*. From September 5, 2006, through March 15, 2007, 1,362 samples were cultured for *E. coli*.

Overall, at least one sample was found culture-positive for commensal *E. coli* on 100 percent of sites, 98.7 percent of barns, and 96.6 percent of pens. Additionally, 94.9 percent of samples were culture positive. These isolates were tested for resistance to a panel of 15 antimicrobial drugs.** Resistance break points used by the National Antimicrobial Resistance Monitoring System were used to classify isolates as susceptible, intermediate, or resistant.

Antimicrobial susceptibility

A total of 1,292 fecal samples were positive for *E. coli* and subjected to susceptibility testing. Two isolates died before susceptibility testing. Overall, 5.5 percent (71 of the remaining 1,290 *E. coli* isolates) were susceptible to all antimicrobial drugs tested. All isolates were susceptible to amikacin, ceftriaxone, ciprofloxacin, and naladixic acid.

Resistance to tetracycline was most common (91.5 percent of isolates), followed by sulfisoxazole (44.8 percent). Table 1 depicts the frequency of resistance among the 1,290 isolates to the 15 antimicrobial drugs tested.

* States

Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas and Wisconsin.

** Amikacin, amoxicillin/clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, naladixic acid, streptomycin, sulfisoxazole, tetracycline, and trimethoprim/sulfamethoxazole.



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Table 1. Number and Percentage of *E. coli* Isolates Resistant* to the Following Antimicrobials

Antimicrobial	Number	Percent
Tetracycline	1,180	91.5
Sulfisoxazole	578	44.8
Ampicillin	362	28.1
Kanamycin	334	25.9
Streptomycin	304	23.6
Chloramphenicol	170	13.2
Trimethoprim/ sulfamethoxazole	64	5.0
Amoxicillin/ clavulanic acid	29	2.2
Gentamicin	25	1.9
Cefoxitin	20	1.6
Ceftiofur	15	1.2
Naladixic acid	0	0
Ciprofloxacin	0	0
Ceftriaxone	0	0
Amikacin	0	0

*Intermediate isolates were classified as not resistant.

Overall, 94.5 percent of isolates were resistant to at least one antimicrobial drug, and 62.6 percent were resistant to more than one antimicrobial drug. The highest percentage of isolates (31.9 percent) showed resistance to only one drug (table 2). Eleven isolates (0.8 percent) were resistant to 7 or more drugs.

Table 2. Number of Antimicrobials by Number and Percentage of *E. coli* Isolates Showing Resistance*

Number of Antimicrobials	Number <i>E. coli</i> Isolates	Percent <i>E. coli</i> Isolates
0	71	5.5
1	411	31.9
2	247	19.1
3	246	19.1
4	195	15.1
5	86	6.7
6	23	1.8
7 or more	11	0.8
Total	1,290	100.0

*Intermediate isolates were classified as not resistant.

The following six antimicrobial resistance patterns accounted for over one-half of isolates (55.7 percent): tetracycline alone (30.3 percent); sulfisoxazole and tetracycline (6.5 percent); kanamycin, streptomycin, sulfisoxazole, and tetracycline (5.5 percent); ampicillin and tetracycline (5.0 percent); ampicillin, sulfisoxazole, and tetracycline (4.8 percent); and streptomycin and tetracycline (3.6 percent).

Conclusions

Although over 60 percent of *E. coli* isolates were resistant to more than one antimicrobial, less than 1 percent were resistant to seven or more antimicrobials.

References

- 1 Rangel, J.M., P.H. Sparling, C. Crowe, P.M. Griffin, and D.L. Swardlow. 2005. Epidemiology of *Escherichia coli* O157:H7 outbreaks, United States, 1982–2002. *Emerg Infect Dis*; 11:603–609.
- 2 Fratamico, P.M., L.K. Bagi, E.J. Bush, and B.T. Solow. 2004. Prevalence and characterization of Shiga toxin-producing *Escherichia coli* in swine feces recovered in the National Animal Health Monitoring System's Swine 2000 study. *Appl Environ Microbiol*; 70:7173–7178.

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